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AN ECOLOGICAL STUDY ON VALLEY-FOREST SPIDERS FROM NORTHERN KENTUCKY

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As far as can be discerned no one has compared the spider faunas of relict vs disturbed forest regions in the Cumberland Mountains. A number of studies have been carried out on the ecology of soil arachnids in forests (Gasdorf and Goodnight, 1963; Elliot, 1930; and others) and several taxonomic lists are available for certain forested regions, such as that of Jones (1940), but such lists are not available for any Kentucky locality.

The Study Area: The Cumberland Mountains of Kentucky offer widely variable habitats, certain parts of them representing some of the oldest undisturbed habitat in North America. Parts of the Red River Drainage in the northern part of the state are of this nature. Particularly instructive are some tributary canyon systems of the middle fork of the stream, lying in Wolfe and Powell counties. In this region, the authors have commenced a long-term ecological analysis, special emphasis being accorded the Arachnida, Chilopoda, Diplopoda and Mollusca.

In the canyon systems alluded to, the valley floors are mostly underlaid by undifferentiated Mississippian rocks, whereas the valleys themselves are incisions through the much interdigitated Lee Formation, directly underlaid by the Breathitt Formation; the latter is exposed on the floors. The Breathitt Formation consists primarily of gray, micareous siltstones, gray, subgraywacke sandstone, dark and light claystones containing some ironstone concretion, some limestone (sparse), chert and coal. The rugged, narrow valleys with steep cliffs are supported by this formation. The overlying Lee Formation forms even more massive cliffs, from 200 to 300 feet high (vertical), and consist mostly of resistant sandstone and siltstone, relatively little clay, ironstone and limestone being present.

The canyon systems here considered head approximately ⅘ mile

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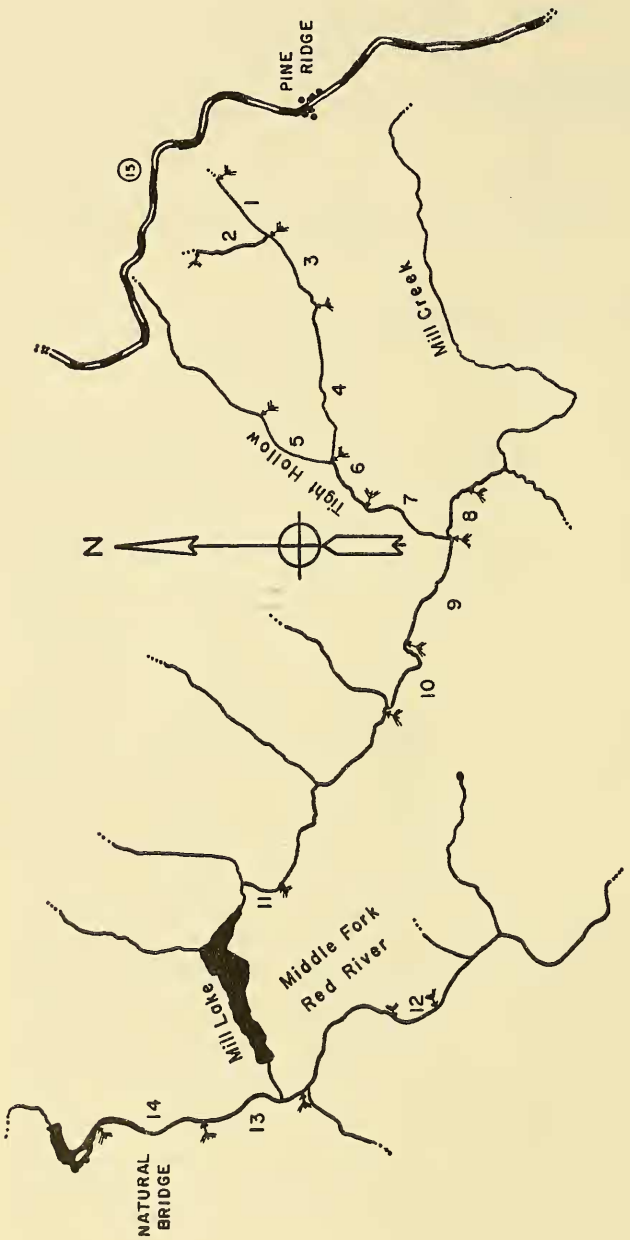

FIGURE 1. Map showing collecting station. See text for details.

northwest of Pine Ridge, Wolfe County, Kentucky (Map 1). These are associated with Tight Hollow Creek, Mill Creek and the Middle Fork of Red River, the latter lying in Powell County. The Tight Hollow system drains 0.558 square mile, and it is three-pronged, roughly Y-shaped. The south arm, which also receives a short, deep bifurcation, heads at 1,040 feet mean sea level (MSL), and extends 2.4 miles to its confluence with the northern arm. The cliffs at the head are of sandstone, averaging slightly more than 200 feet in height and are vertical, concave risers. Below this point, the cliffs are of variable height, but always steep, the enclosed valley narrow and rocky. The northern arm heads at 1,240 feet MSL and makes contact with the southern arm at 1,030 feet two miles below the origin. It is similar in topography to the southern arm. Following this, the lower arm (Fig. 1) extends 2,225 feet to Mill Creek Canyon, at 900 feet MSL. From this point, the canyon meanders between steep walls for 12,000 feet to open into the much wider canyon of the Red River, receiving the small canyons of Doe Branch, Black John Creek, and Doublecave Branch, all of these being very similar to Tight Hollow.

Generally speaking, these canyon systems lie in mixed mesophytic forest land. The dominant trees are *Betula lenta* Linnaeus, *Tsuga canadensis* Carr, *Liriodendron tulipifera* Linnaeus, *Acer rubrum* Linnaeus, *Cornus florida* Linnaeus and *Magnolia fraseri* Walt. On the south ridge *Ilex opaca* Ait is abundant from station 6 upgrade. From stations 1 through 5, *Rhododendron maximum* Linnaeus is exceedingly dense, up to 2,117 main stalks per acre being counted in some places. Below station 5, this species is progressively replaced by mountain laurel (Fig. 2). A similar relationship was observed between the hemlock and tulip tree (Fig. 3), and also hemlock versus pines (White, Virginia). This is a reflection of past logging. Stations 1 through 5 lie in a relatively undisturbed, relictual area, whereas the stations below 5 have been variously disturbed by farming, deforestation and some rather insignificant silver mining.

Of the ground vegetation various species of Polypodiaceae, *Sedium, Lygodium, Lycopodium* and numerous mosses are the most abundant in the upper stations, with some dense stands of *Equisetum arvense* Linnaeus along the creek and thick growths of *Mitchella repens* Linnaeus on the drier slopes. Downstream, several grasses have invaded clearings. In the undisturbed areas there is a thick litter of leaves and needles, in addition to logs in various stages of decomposition.

Collecting Stations: Collections were secured from fourteen localities, as indicated in Figure 1. The limits of each station are demarked by arrows. A swath-transect, set at right angles to the long axis of the valley, was followed from crest to crest. Temperature readings, air at standard level, soil at six inches, are in centigrade.

Station 1. 26 February 1966. The valley is narrow with vertical cliffs and several old talus slides; numerous fallen logs; vegetation dense, moss, ferns, Liverworts; heavily shaded by *Tsuga, Magnolia,* and a large pop-

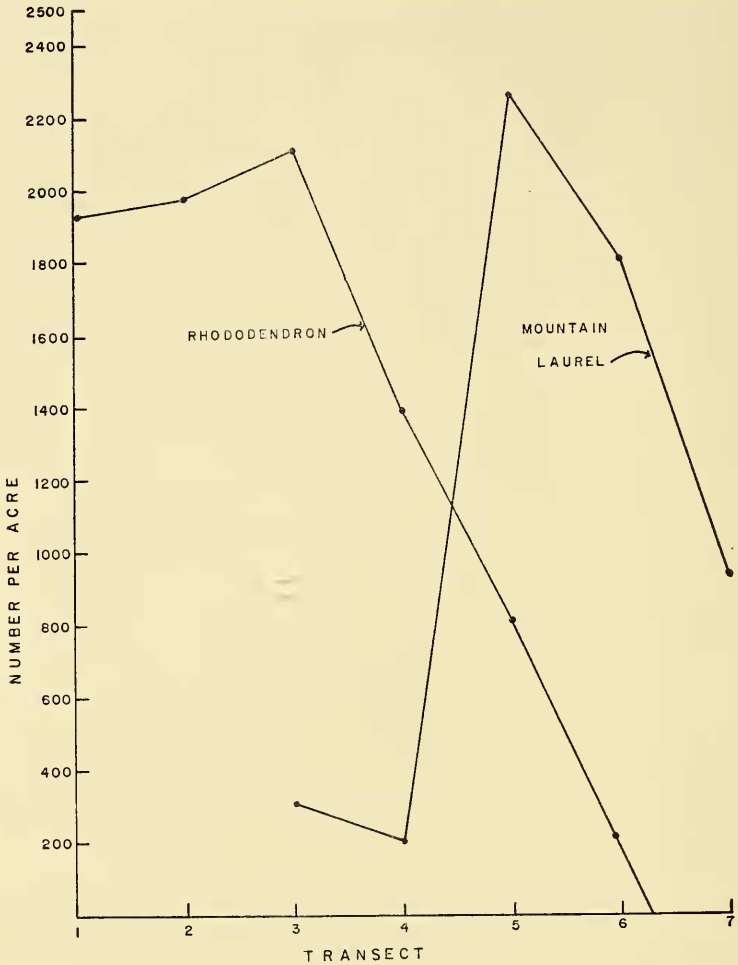

FIGURE 2. Importance values of *Rhododendron* versus Mountain Laurel.

ulation of *Rhododendron* and *Ilex;* considerable ground seepage. Temperature: soil, 3.0; air, 2.0.

Station 2. 5 March 1966. Valley walls steep, V-shaped in section; many flat sandstones; considerable topsoil (washed in from above); vegetation as in station 1. Temperature: soil, 5.0; air, 5.5.

Station 3. 12 March 1966. Valley walls less declivitous; U-shaped; much organic debris; vegetation as in station 1. Temperature: soil, 6.0; air, 15.0.

Station 4. 19 March 1966. Slope of valley walls continues to ameliorate; a modest floodplain (100 feet in width) produced, composed of gravel, mud, large and small sand-rocks, and deep organic litter. Temperature: soil, 7.5; air, 10.0.

Station 5. 26 March 1966. Nearly identical to station 4. Temperature: soil, 6.0; air, 10.0.

Station 6. 2 April 1966. Valley much wider, slope of walls more gentle, supporting numerous flowing springs; *Tsuga* partially replaced by white pine, and *Rhododenron* by *Kalmia.* Temperature: soil, 7.0; air, 10.7.

Station 7. 9 April 1966. Similar to station 6, but valley reverts to a narrow V-configuration, with steep walls; considerable ironwood and maple; practically no *Rhododendron;* large boulders, rubble, dead logs. Temperature: soil, 6.0; air, 7.8.

Station 8. 23 April 1966. Mill Creek Valley; wide, the slope of walls only moderate; floodplain two to three hundred yards wide, gently inclined toward the creek and covered with grasses, sedges, sumac, various weedy species, *Lobelia,* willow and dogwood; some boulders, small stones, rubble and organic siltation. Temperature: soil, 16.0; air, 19.7.

Station 9. 14 May 1966. Similar to station 8, but walls even less steep; floodplain with more grass and much sand; a few abandoned silver mines. Temperature: not taken.

Station 10. 22 May 1966. Similar to station 9, but valley wider. Temperature: soil, 11.5; air, 21.5.

Station 11. 25 June 1966. Here the valley has been impounded by a small dam. Around the margins of the lake are many dead trees, standing and fallen. Otherwise conditions are quite similar to those at station 9, though the valley is somewhat deeper and narrower, since the average slope is increased. Just below this point, Mill Creek empties into the Middle Fork of Red River. Temperature: soil, not taken; air, 34.0.

Station 12. 11 June 1966. Valley of Middle Fork of Red River. Valley much wider, floodplain nearly a mile wide in places, under agriculture in places (corn and tobacco), and numerous old-field seres evident; willow, sycamore, tulip trees, hawthorn, few pines and young *Tsuga.* Temperature: soil, 17.0; air, 23.7.

Station 13. 2 July 1966. Valley wide, floodplain about 80 feet wide on either side of river; weeds, dead leaves, flat sandstones; vegetation as in station 12. Temperature: soil, 22.5; air, 32.0.

Station 14. 9 July 1966. Similar to station 13, but stream bank heavily overgrown by kudzu. Temperature: soil, not taken; air, 30.2.

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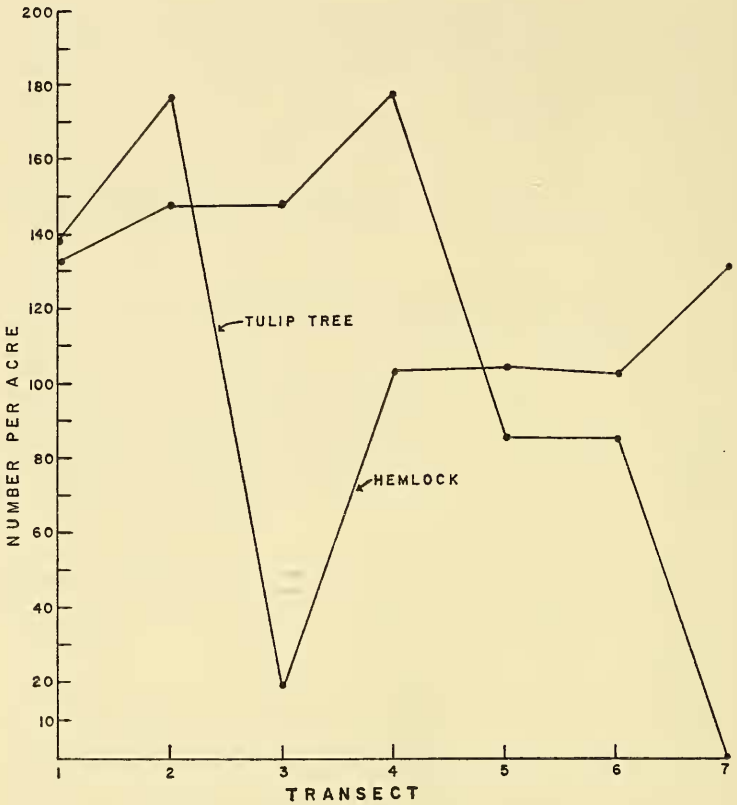

FIGURE 3. Importance values of hemlock versus tulip tree.

Methods: At each collecting station shown in Figure 1, a 12-foot wide swath, located at the center of each area, was hand collected from one rim of the valley to the other. Most of our efforts were directed toward securing specimens from the ground stratum, although vegetation was searched up to a height of six feet.

No attempt has been made to analyze in detail seasonal effects, although the authors are quite aware of its profundity as regards population fluctuations (Gasdorf and Goodnight, 1963). However, Figure 4 demonstrates an obvious increase in both total numbers and the percentage-composition of mature versus immature forms. It is perhaps interesting to note the relatively large figures shown on the graph for March 13. This probably reflects an unusual warming tendency during the week immediately preceding, in which the air temperature climbed to approxi-

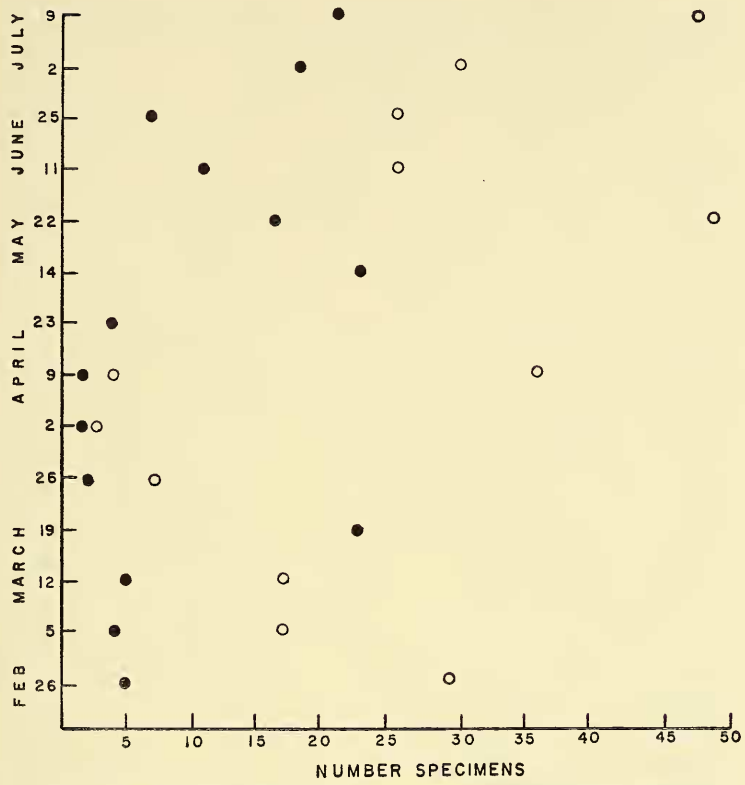

FIGURE 4. Spiders collected at study areas in Wolfe and Powell counties, Kentucky as a reflection of advancing season. Solid circles, total numbers collected; open circles, immature forms as percentages of total.

mately 15° C. Following this, temperatures fell back to 10° C and remained there until the middle of April.

Consequently, in the following discussion two primary objectives are met. (1) The fauna of the undisturbed area (Stations 1 through 5) is compared with that of the progressively more disturbed (Stations 6 through 14). A third objective should probably be included, i.e., reporting the species included; very little work has been attempted on the Kentucky Arachnida. (2) The general ecology of the species collected is discussed.

Results: Seventy-seven species of spiders were collected during a six-month period, from February through July, from the study area delineated above. These species were distributed through 61 genera and 19 families. Of the total number collected, 70 percent were females, 17

TABLE 1. Comparison of spiders taken by random swath collecting in a northern Kentucky valley system, 1966. Numbers refer to collecting stations.

Species	Undisturbed	Disturbed	Shared
Antrodiaetus	2, 5		
Ariadna bicolor		9	
Achaearnea tepidariorum		12, 14	
Latrodectus mactans		7	
Theridion rupicola		12	
Theridion albidum		13	
Frontinella communis		9	
Pityohyphantes phrygianus	3	9, 11	X
Helophora insignis	5		
Lepthphantes sp.		10	
Linyphia marginata		12	
Linyphia maculata		13	
Microneta varia	1, 3		
Ceraticelus sp.		6, 13	
Erigone		13	
Micrathena gracilis		7, 14	
Micrathena mitrata		7	
Meta menardi		9	
Mangora placida		9, 10, 12	
Mangora maculata		14	
Neoscona sp.	3	7	X
Epeira raji	1, 5	7	X
Aranea sp.		14	
Theridiosoma sp.		9	
Theridiosoma gemmosum		11	
Leucauge venusta		6, 12, 13	
Tetragnatha versicolor		7, 10	
Tetragnatha elongata		7, 8, 11, 12	
Tetragnatha sp.		9, 10, 11	
Cybaeus	1, 2, 3, 4, 5	6	X
Cicurina sp.	2, 3, 5	7, 10, 14	X
Cicurina robusta	4, 5		
Cicurina brevis	1, 3	6	X
Agelenopsis pennsylvanicus		11, 12, 13, 14	
Wadotes sp.	1, 3, 4, 5	7, 8, 10	X
Wadotes carolinus	2, 4, 5	6	X
Wadotes calearatus	3	6	X
Coras sp.			
Coras lamellosus		9	
Coras montanus		7	
Coras tangynus	2, 3, 4	6	X
Calymmaria sp.	2, 3		

TABLE 1 (Continued)

Species	Undisturbed	Disturbed	Shared
Tegenaira sp.	4	6	X
Hahnia cinerea		13	
Dolomedes sp.		13, 14	
Dolomedes scriptus	3		
Dolomedes tenebrosus	4	6	X
Dolomedes urinator		12	
Dolomedes vittatus		12	
Pirata sp.	3	12	
Pirata montanus		9, 10	
Pirata maculatus		13	
Pardosa sp.	4, 5	6, 9, 12, 13	X
Trocosa sp.		9	
Schizocosa sp.		9	
Schizocosa crassipes		10, 11, 12, 13, 14	
Lycosa helluo		8, 10, 11	
Zelotes duplex		10	
Drassyllus virginianus		10, 13	
Anahita sp.	3, 4, 5	6, 11, 12, 13, 14	X
Anahita punctulatus		10	
Micaria sp.	4		
Trachelas sp.	1		
Clubiona sp.	5		
Clubionoides texana		9	
Castianeira longipalpus		11	
Agroeca minuta		13	
Phrurotimpus alarius		9, 11, 14	
Anyphaena pectorosa		13	
Oxyptila sp.		11	
Xysticus elegans		11	
Xysticus ferox		12, 14	
Philodromus rufus	2		
Habrocestum pulex	5		
Habrocestum acerbum		12, 14	
Thiodina sp.		10	
Pellenes		10	
Habronattus sp.		9	
Paraphidippus sp.	3, 4		
Neon nelli		8	
Maevia vittata		6, 13, 14	

percent were males, and 13 percent were immature forms. Since most of our efforts were confined to species occupying the ground stratum those data for web-building or foliage hunters, such as *Frontinella communis* and *Micrathena,* are not significant.

As noted by Whitcomb, Exline, and Hite (1963), and as illustrated by Table 1, lycosids have a decided preference for more or less open areas. The arrangement of our collecting stations, beginning in the narrow, steeply declivitous portion of the valley system and extending downgrade into the wider, less declivitous portion, is strongly reflected by spider distribution, as illustrated in the Table. This is probably because of an increase in habitat diversity in the lower stretches, and because considerably more moisture is available around the year. The narrow parts of the valleys become very dry, except precisely on the floor, during the summer months.

This same picture is obvious in the whole spider fauna (Table 1), both from the standpoint of numbers of species present and numbers of individuals. When the effect of advancing season is considered, it does not appear that the relict, undisturbed area has retained a significantly different spider fauna than the areas in the disturbed.

Ecological Annotations

Antrodiaetus species. Lives in burrows, mostly beneath fallen logs and deep litter. Males observed on surface during late winter.

Ariadna bicolor (Hentz). Primarily found beneath the loosened bark of dead trees, fallen or standing.

Achaearanea tepidariorum (Koch). This species is seldom found far from human habitations. Stations 12 and 14 are both in close proximity to various buildings. Our specimens were secured beneath large rocks.

Latrodectus mactans (Fabricius). The single specimen was found beneath a rock near an abandoned farm site.

Theridion rupicola Emerton. Beneath a large piece of bark on the ground.

Theridion albidum Banks. In a clump of partridge pea, near valley floor.

Frontinella communis (Hentz). In web on a small white pine.

Lepthyphantes sp. In leaf litter.

Linyphia marginata Koch. On base of white pine.

Linyphia maculata Emerton. On face of upright rock wall.

Pityohyphantes phrygianus (Koch). On ground, open floor of valley; not under trees.

Helophora insignis (Blackwell). On tall grass at the margin of Mill Creek.

Microneta varia (Blackwell). Under dead leaves on ground; deep shade.

Ceraticelus sp. On ground in leaf litter.

Erigone sp. On ground in leaf litter.

Micrathena gracilis (Walckenaer).

Micrathena mitrata (Hentz).

Neoscona sp.

Aranea sp.

The last four forms were all secured from orb webs on low vegetation.

Epeira raji (Scopoli). This species builds a large orb web, but hides in a rolled leaf about five feet above the ground.
Mangora placida (Hentz). In a small orb web located approximately eight inches above the ground.
Mangora maculata (Keyserling). In a small orb web at about shoulder height above the ground.
Meta menardi (Latreille). Under a deeply placed monolith of large size.
Theridiosoma sp.
Theridiosoma gemmosum (Koch).

The last two forms were removed from some liverworts on the face of a cliff, near the valley floor.

Leucauge venusta (Walckenaer).
Tetragnatha versicolor Walckenaer.
Tetragnatha elongata Walckenaer.

The last three forms were all found on limbs and twigs extending out above the creeks. When approached, they flatten themselves against twigs, their legs held parallel to the long axis of the body.

Agelenidae. All the funnelweb spiders in this area were secured from the ground level, either running or under stones, logs, and debris.
Dolomedes. The four species of this genus are more or less restricted to stream and pond margins. Several specimens were removed from the water. Since first order streams in this region periodically cease running in the summer, the greater abundance of these forms in the lower parts of the canyon system is probably correlated with the constant water supply found there.
Lycosidae. With the exception of *Pirata montanus* Emerton, which prefers shaded ravines, all the wolf spiders here discussed are species of the lower altitudes, at the edge of the forest, and in cleared areas.
Zelotes duplex Chamberlin. Under a stone in tall grass on the floodplain.
Drassyllus virginianus Chamberlin. On leaf litter.
Anahita punctulatus. Under rocks, large pieces of bark on the ground, and dead logs.
Micaria sp.
Clubiona sp.
Clubionoides texana.
Castiameira longipalpus (Hentz).
Agroeca minuta Banks.
Phrurotimpus alarius (Hentz).

The last six forms were all secured from leaf litter, chiefly on the slopes.

Trachelas sp. Beneath a clump of grass near the creek.
Anyphaena pectorosa Koch. In *Scirpus*, about a foot above the ground, near the creek.
Oxyptila sp. In leaf litter.
Xysticus ferox (Hentz). Under rocks and on ragweeds.
Xysticus elegans Keyserling. Wandering on the ground.

Philodromus rufus Walckenaer. On a fallen log.
Habrocestum pulex (Hentz).
Habrocestum acerbum.

The last two species were removed from bare rocks.

Thiodina sp.
Pellenes sp.

The last two forms were found in leaf litter.

Habronattus sp. In tall grass near the creek.
Neon nelli Peckham. On fallen pine needles.
Maevia vittata (Hentz). Under logs and fallen bark.

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